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Indian Standard

PRECONDITIONING, CONDITIONING AND TESTING OF SOLID ELECTRICAL INSULATING MATERIALS

(First Revision)

Second Reprint FEBRUARY 1999

UDC 621.315.61 : 620.1

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Gr 3 *April* 1973

Indian Standard
PRECONDITIONING, CONDITIONING AND TESTING OF SOLID ELECTRICAL INSULATING MATERIALS
(First Revision)

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Indian Standard
PRECONDITIONING, CONDITIONING AND TESTING OF SOLID ELECTRICAL INSULATING MATERIALS
(First Revision)

0. FOREWORD

0.1 This Indian Standard (First Revision) was adopted by the Indian Standards Institution on 5 January 1973, after the draft finalized by the Insulating Materials Sectional Committee had been approved by the Electrotechnical Division Council.

0.2 Certain properties of insulating materials are affected by the temperature or humidity, or both of the atmosphere to which they are subjected. When testing electrical insulating material it, therefore, becomes usually necessary to have controlled atmospheric conditions, to which the specimens are subjected prior and during the test.

0.3 While indicating results of tests for electrical insulating materials which are likely to be affected by the atmospheric conditions, it is important that the relevant conditions to which the test specimens were subjected are indicated. Specifications for such materials should, therefore, cover the atmosphere to which the test specimens should be exposed before testing and the conditions under which the tests are to be made.

0.4 The range of conditions covered in this standard is sufficiently wide to enable suitable conditions to be selected so that either of the primary objects of conditioning may be achieved. These objects are:

a) To obtain greater reproducibility of test results by:
   1) partly counteracting the variations of properties of the material due to the past history of the test specimens (often known as ' normalizing ', here called preconditioning); and
   2) ensuring uniformity of conditions during testing.

b) To determine the influence of exposure to certain temperatures and humidities, or immersion liquids, on the properties of a material by subjecting specimens to the specified conditions before or during the test, or both.

0.5 This standard was originally published in 1963 based on IEC Doc: 15 (Secretariat) 48 ' Draft recommended standard conditions for use during the preconditioning, conditioning and testing of solid electrical insulating materials ' and to as amended in 1965 to include a clause on ' Code for specifying preconditioning, conditioning and testing '. This revision has been undertaken to bring this standard in line with IEC/Pub 212 (1971) ' Standard conditions for use prior to and during the testing of solid electrical insulating materials ' issued by the International Electrotechnical Commission.

0.6 For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test, shall be rounded off in accordance with IS : 2-1960*. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

1. SCOPE

1.1 This standard lays down the standard conditions of exposure time, temperature, atmospheric humidity and liquid immersion for use in preconditioning, conditioning and testing of solid electrical insulating materials.

2. TERMINOLOGY

2.0 For the purpose of this standard, the following definitions shall apply.

2.1 Preconditioning — The treatment of a specimen with the object of removing or partly counteracting the effect of its previous history with respect, principally, to the temperature and humidity to which it has been exposed. This treatment (sometimes known as ' normalizing ') usually precedes conditioning of a specimen.

2.2 Conditioning — The subjection of the specimen to an atmosphere of a specified relative humidity, or complete immersion in water or other liquid, at a specified temperature for a specified period of time.

NOTE — When the combination of temperature and humidity for conditioning is the same as that prescribed for preconditioning, the preconditioning and conditioning may be merged and the preconditioning may be said to take the place of conditioning.

2.3 Test Conditions — The temperature and humidity of the atmosphere surrounding the specimen, or temperature and kind of liquid (for liquid immersion), at the time tests are carried out.

2.4 Standard Reference Atmosphere — The atmosphere to which values measured under any other atmospheric conditions are corrected by calculation.

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*Rules for rounding off numerical values (*revised*).

2.5 Relative Humidity — The ratio of the actual vapour pressure to the saturation vapour pressure at the same (dry bulb) temperature, expressed as a percentage.

3. TEMPERATURE AND HUMIDITY (OR LIQUID IMMERSION) FOR PRECONDITIONING, CONDITIONING AND TESTING

3.1 The conditions of temperature and humidity (or liquid immersion) for preconditioning, conditioning and testing are given in Tables 1 and 2.

3.1.1 A suitable method of achieving relative humidity of 65 percent is given in Appendix A.

3.2 When preconditioning is required, standard atmosphere or one of the dry-hot conditions given in Table 1 may be used for a time specified in the material specification (for example, 24 ± 1/2 hour). It is usual to specify 50 ± 2°C with a relative humidity less than 20 percent.

4. PERIOD OF CONDITIONING

4.1 The period of conditioning should be specified in the relevant material specification or test method. The period of conditioning will usually depend upon the type of material being tested.

Note — In general, it is not intended that the period of conditioning shall be sufficient to enable the specimens to reach equilibrium with the surrounding atmosphere. The rate at which equilibrium is reached depends largely upon the nature and dimensions of the test specimens. Consequently, the period of exposure necessary to obtain equilibrium may in some cases (for example, thin paper) be only a matter of a few minutes, but in others (such as, hard rubber) it may be many months.

4.2 The periods of conditioning be selected from the list given in Table 3.

5. PROCEDURES FOR ATMOSPHERIC PRECONDITIONING, CONDITIONING AND TESTING

5.1 Whenever possible, tests should be made on specimens in a room or in a suitable chamber in which the required conditions are maintained throughout the test.

5.2 Where the conditions in the testing room do not differ materially from the required conditions and/or the property of the material is not likely to be affected appreciably by transfer from the required conditioning atmosphere to the testing atmosphere, test specimens may be conditioned (for example, in a suitable chamber), and rapidly transferred to the testing room atmosphere, the tests being made within a few minutes of such transfer. This is admissible only when so indicated in the specification concerned which should, where necessary, specify the maximum period allowed between the transfer and the test.

TABLE 1 STANDARD ATMOSPHERIC CONDITIONS FOR TESTING AND CONDITIONING

(*Clauses* 3.1, 3.2 *and* 8.1.4)

CONDITION* DESIGNATION OF THE CONDITION	TITLE	TEMPERATURE† °C		RELATIVE HUMIDITY‡ PERCENTAGE	
(1)	(2)	(3)		(4)	
R	As received	—		—	
(Hours)h/15-35C/45-75 percent	Standard ambient	1 to 35		45 to 75	
(Hours)h/27C/65 percent	Standard atmosphere	27	± 2	65 ± 5	
(Hours)h/23C/93 percent	Damp	23		93	± 2
(Hours)h/40C/93 percent	Damp-warm	40		93	
(Hours)h/55C/93 percent	„ „	55		93	
(Hours)h/15-35C/< 1·5 percent	Dry	15 to 35		Less than 1·5	
(Hours)h/55C/<20 percent	Dry hot	55	± 2	Low (less than 20)	
(Hours)h/70C/<20 percent	„ „	70			
(Hours)h/90C/<20 percent	„ „	90			
(Hours)h/105C/<20 percent	„ „	105			
(Hours)h/120C/<20 percent	„ „	120			
(Hours)h/130C/<20 percent	„ „	130			
(Hours)h/155C/<20 percent	„ „	155			
(Hours)h/180C/<20 percent	„ „	180			
(Hours)h/200C/<20 percent	„ „	200	± 3	„	
(Hours)h/220C/<20 percent	„ „	220			
(Hours)h/250C/<20 percent	„ „	250			
(Hours)h/ 275C/<20 percent	„ „	275	± 5	„	
(Hours)h/320C/<20 percent	„ „	320			
(Hours)h/400C/<20 percent	„ „	400			
(Hours)h/500C/<20 percent	„ „	500	± 10	„	
(Hours)h/ 630C/<20 percent	„ „	630			
(Hours)h/800C/<20 percent	„ „	800	± 20	„	
(Hours)h/1 000C/<20 percent	„ „	1 000			
(Hours)h/-10C/-	Cold	—10	± 3	„	
(Hours)h/-25C/-	„	—25			
(Hours)h/-40C/-	„	—40			
(Hours)h/-55C/-	„	—55			
(Hours)h/-65C/-	„	—65			

*The periods for preconditioning and conditioning (represented by "Hours" in col 1) should be specified in the material specification and should be selected from Table 3.

†In special cases, closer tolerances may be used, for example, ± 1°C and ±2 percent relative humidity.

‡When the testing specification requires a period of preconditioning or conditioning, it is important to distinguish between the overall limits of the temperatures within which it may be carried out, and the limits within which the temperature must be maintained in order to keep within the specified relative humidity limits, for example, the temperature tolerances in col 3 will not in themselves ensure the close relative humidity control required by col 4.

TABLE 2 LIQUID IMMERSION CONDITIONS FOR TESTING AND CONDITIONING

(*Clauses* 3.1, 6.1 *and* 8.1.4)

CONDITION* DESIGNATION (1)	TITLE (2)	LIQUID (3)	TEMPERATURE† (4) °C	
(Hours)h/27 ± 0·5C/water	Standard water immersion	Distilled water or water of equivalent purity (de-ionized water)	27 ± 0·5	
(Hours)h/27C/(liquid)	Liquid immersion	As designated	27	± 2
(Hours)h/50C/(liquid)	"	"	50	
(Hours)h/70C/(liquid)	"	"	70	
(Hours)h/90C/(liquid)	"	"	90	
(Hours)h/105C/(liquid)	"	"	105	
(Hours)h/120C/(liquid)	"	"	120	
(Hours)h/130C/(liquid)	"	"	130	

*The period of immersion (represented by 'Hours' in col 1) shall be specified in the material specification and shall be selected from Table 3.

†*For special tests, closer tolerances may be required,* as for instance ± 0·5°C in place of ± 2°C.

TABLE 3 LIST OF PREFERRED PERIODS FOR PRECONDITIONING AND CONDITIONING

(*Clause* 4.2)

Hours	1	2	4	8	16	24		48		96
(Weeks)	1	2	4	8	16		26		52	

5.3 Any technique may be used for obtaining the required conditions, for example, controlling temperature and humidity in the room or chamber in which the test specimens are maintained prior to test and in which the tests are made or enclosing the test specimens in a chamber, oven or other enclosure in which the required conditions are maintained throughout the preconditioning, conditioning and/or test operations.

5.3.1 Care should be taken to allow free access of the conditioning atmosphere to all the specimens, and to ensure uniform conditions throughout the conditioning atmosphere in the neighbourhood of the specimens.

When dry-hot conditions are used, the oven should be ventilated.

5.3.2 When some materials are conditioned, harmful products may develop and it is, therefore, important to prevent these from contaminating specimens of other materials.

5.3.3 When measuring leads are passed through the wall of a chamber, care should be taken to prevent significant leakage paths in parallel with the electrodes or measuring instrument, for example, over the surfaces of the insulation of the leads.

6. PROCEDURE FOR LIQUID IMMERSION CONDITIONING AND TESTING

6.1 The temperatures for liquid immersion, conditioning and testing are given in Table 2. Specimens should be preconditioned, if specified, and immersed in the liquid at the specified temperature for the required time given in the material specification.

6.1.1 Care should be taken to allow free access of the liquid to all the specimens and to ensure uniform conditions throughout the liquid in the neighbourhood of the specimens.

6.1.2 When some materials are conditioned, harmful products may develop and it is, therefore, important to prevent contamination of specimens of other materials.

6.2 If the specimen cannot be tested in the liquid, it should be taken from the liquid and the surface liquid removed by pressing with clean dry filter or blotting paper or by wiping with a clean absorbent cloth before testing.

6.3 The test should be commenced immediately after the surplus liquid has been removed, and completed as soon as possible. The maximum time between the removal of the specimen from the liquid and the measurement should be specified in the material specification.

7. STANDARD REFERENCE ATMOSPHERE

7.1 Standard reference atmosphere shall be as follows (*see* IS : 196-1966*):

Temperature	27°C
Relative humidity	65 percent
Pressure	1 013 mbar

7.2 When it is desired to correlate results of tests which have been obtained at different temperature and/or humidities, the results should be reduced to the standard reference atmosphere with the help of conversion factors that are established for a particular material and test on the basis of adequate available information.

8. CODE FOR SPECIFYING PRECONDITIONING, CONDITIONING AND TESTING

8.1 Where it is desired to use a code for describing conditions for preconditioning, conditioning and testing the code given in Table 4 may be used.

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*Atmospheric conditions for testing (*revised*).

TABLE 4 CODE FOR SPECIFYING PRECONDITIONING, CONDITIONING AND TESTING

(*Clause* 8.1)

CONDITIONING	CODE
(1)	(2)
As received	R
Atmospheric preconditioning and conditioning	(Hours)h/(Temp)C/(RH) percent
Immersion conditioning	(Hours)h/(Temp)C/liquid
Testing (M)	M/(Temp) C/(RH) percent

8.1.1 When the conditioning time is in weeks, the time portion of the code may be expressed as weeks (W).

8.1.2 When preconditioning is used before conditioning, the two codes should be connected with a plus sign (+). A semicolon should separate the conditioning code from the testing code. Thus, if a specimen is to be preconditioned for 48 hours at 50°C and less than 20 percent RH, conditioned for 96 hours at 23°C and 50 percent RH and tested in the same atmosphere, the code would read:

48 h/50C/<20 percent + 96 h/23C/50 percent; M/23C/50 percent

8.1.3 If preconditioning is not to be used, the first part of the code is omitted.

8.1.4 If closer tolerances are required than those designated in Tables 1 and 2, the tolerance should be included in the code as, for instance, 96 h/20 ± 0·5C/93 ± 1 percent.

APPENDIX A

(*Clause* 3.1.1)

METHOD FOR ACHIEVING STANDARD RELATIVE HUMIDITY

A-1. A convenient method of achieving an atmosphere of relative humidity of 65 percent at a temperature of 27 ± 1°C is by the use of saturated solution of sodium chloride and sodium nitrate exposed to the atmosphere in an enclosed chamber where it is desired to have the required humidity.

A-1.1 The saturated solution is prepared by boiling in water a mixture of one part by weight of sodium chloride and 2¼ parts by weight of sodium nitrate. The solution is then cooled and more of the solid mixture is added than what may be taken into solution.

A-1.2 The saturated solution shall be exposed so that maximum surface is in contact with the air in the chamber, for example, by covering the floor of the chamber with a tray containing the saturated solution. To ensure that the solution remains saturated, an excess of the solid salt shall be contained in the liquid. It is important that the solid remains covered by the solution and that the surface of the liquid is free from any crust of film of grease, dirt, etc.

A-1.3 To ensure uniform conditions throughout the chamber, a fan should circulate air over the surface of the saturated solution and around the specimens. Care should be taken to allow free access of the conditioning atmosphere to all specimens.

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Printed at New India Printing Press, Khurja, India